FLUID SAMPLE COLLECTION AND DISTRIBUTION SYSTEM

ORIGIN OF THE INVENTION

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics Space Act of 1958, public law 85-568 (72 Stat. 435; 42 U.S.C. 2457).

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to methods and apparatus for collecting an aqueous sample for use in making a qualitative analysis of the sample to determine the condition thereof. More particularly, the invention relates to methods and apparatus for automatically and continuously collecting samples from any one of a plurality of sampling points, filtering part of the samples collected and delivering both unfiltered and filtered samples to various analyzing sensors for making a determination of the quality of the aqueous supply from which the sample is taken through various electrical, chemical and biological means.

2. Description of the Prior Art

With the increased concern for environmental pollution, methods and apparatus for the qualitative and quantitative analysis of aqueous samples are continually being devised. As these improved methods and apparatus are evolved, the time required to perform the tests necessary has been reduced to the point where the apparatus has been taken out of the laboratory category and is now an on-line process system. However, advances in methods of obtaining samples for analysis, and in particular from a water treatment process plan, have not kept pace with the advances in analysis equipment. Additionally, improvements in the analysis equipment hs levied new requirements for filtration of the samples obtained. Again, performance of prior art filter systems have not kept pace with the new requirements.

In the prior art, systems for collecting fluid samples have for the most part been directed to apparatus which is periodically energized to draw the fluid through a sample chamber and into a collection container. With the older, laboratory-type method of testing, which did not require a high volume of waste water effluent to be collected in a short time interval, these methods were adequate. For example, see Peterson, U.S. Pat. No. 3,986,401, which shows a composite sampling method and system for collecting fluid samples from a high velocity effluent. As above-mentioned, the system comprises a pump which is periodically energized to draw fluids through a sample chamber and into a collection container, which may be connected into a testing apparatus or, more conventionally, with the container being periodically transported to a laboratory for subsequent testing of the contained sample.

Prior art filter systems, particularly those associated with silt laden or wastewater discharge, frequently clog with filtrate, requiring cleaning to unclog the filters. In the past, such cleaning has been provided through a backwash or through a flushing process, sometimes known as a "blow-down", involving a rapid rush of unfiltered liquid over but not through the filter mesh element, forcing the clogging material off the filter to a discharge opening for removal. Both of the above-described methods are particularly adaptable for use with the above-described collection system whereby samples are obtained from a process stream only periodically. However, for a sample collection apparatus designed to provide a continuous flow of filtered and unfiltered sample to be used with modern, quick assay apparatus, it becomes cumbersome and inefficient to periodically interrupt the flow of sample collected in order to clear a clogged filter.

The present invention overcomes the deficiencies in the prior art by providing methods and apparatus for automatically and rapidly providing a continuous flow of sample collected from a plurality of distinct "user" selectable sample points and for providing a plurality of continuous output flows in various stages of filtration whereby interruption of one flow to clear a clogged filter may be programmed around the testing procedure.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus for automatically collecting fluid samples from any one of a plurality of sampling points along a process flow path for delivering a continuous stream of sample to various chemical and biological analytical sensors whereby a determination of the effectiveness of the process treatment may be ascertained. Although some of the sensors require unfiltered water, other sensors which monitor soluble constituents and biological matter utilize water that is filtered to remove particulate matter as small as 0.45 microns.

In one embodiment of the present invention, an aqueous sample is obtained from various locations in a water treatment system by any one of a plurality of sampling valves, each having the ability to pass large particles without becoming clogged. The valves are connected to a pair of progressive cavity pumps which are not susceptible to damage by large particles as would be present in unfiltered sewage. Two pumps are used in the system, with one associated with a plurality of multi-point sample valves and the remaining pump associated with an effluent sample valve. The system is designed with the capability that the multi-point pump can be switched to pump effluent from an interim line, thereby bypassing the effluent pump. Further, the system also has the capability to use effluent to backflush each of the multi-point lines for either priming each multipoint line or for cleaning the line of debris. Each pump additionally has a by-pass loop which enables an operator to manually adjust the amount of new sample being pumped to the filters. A filter with modified backflush system is associated with each pump and includes four timed control solenoid-operated valves, with two valves associated with each filter system to increase the system output. One filter unit is attached to the multi-point pump with both sides of the filter containing a ten-micronsize, stainless-steel, woven filter. The second filter unit is attached to the effluent pump, and contains two different size filters, one filter is a ten-micron filter and one a 0.45-micron filter. Accordingly, it may be seen that there are five different samples that may be obtained from the pumps and filter units. One is an unfiltered multi-point sample which is pumped directly from the multi-point sample valves. The second is a ten-micron filtered multi-point sample obtained from the multi-point pump filter unit. The third is an unfiltered plant effluent sample obtained from the effluent pump and the fourth and fifth being ten-micron filtered plant effluent and 0.45-micron filtered plant effluent